Travel Impacts of the COVID-19 Pandemic Preliminary Analysis

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50 YEARS 1970 – 2020

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Two Views of the Post-Pandemic World

- Carmageddon is coming!
  - Most former transit riders and carpoolers will drive when they return to work
  - As the economy reopens, traffic and congestion will overwhelm highways
- Nobody will drive anywhere, and the Highway Trust Fund will go broke
  - Most people will continue to work and shop at home
  - Permanent reductions in driving and fuel use will starve the HTF
  - But we won't need any road construction, so who cares?
- What should DOT be doing?

What We Did

- Used Vanderbilt University “Rebound Calculator” to estimate changes in commuting times in large urban areas as the economy recovers
- Combined actual data and informed assumptions about factors affecting traffic levels and congestion
  - Job losses and shifts to remote work
  - Shifts from transit and carpool commuting to driving alone
- Examined impacts in urban areas with high and low transit use
- Developed scenarios for gradual resumption of travel activity
- Estimated sustained remote work shares necessary to prevent gridlock

Scenarios We Examined

- Pre-pandemic baseline (Jan.-Feb. 2020)
- Immediate aftermath (March-June 2020)
- Improved testing, diagnosis, and treatment (mid-2021?)
- Widespread vaccination (2022?)
- Lingering or permanent impacts (beyond)

Sample Urban Areas

- Four population size categories
  - Very large: >10 million (New York, Los Angeles)
  - Large: 5-10 million (n=7)
  - Medium: 3-5 million (n=7)
  - Others: 1-3 million (n=6)
- High and low transit use examples in each category
  - Range is wide except in smallest size category
  - Including carpooling (“private transit”) narrows the range

Data Sources and Analysis Tools

- Data sources
  - 2018 American Community Survey (Census Bureau): population, commuting mode shares, carpool composition, commute trip lengths
  - IHS Global Insight: baseline employment, initial losses, and projected recovery
  - Transit agency websites and press reports: ridership losses
  - Univ. of Chicago study (April 2020): *How Many Jobs Can be Done at Home?*
- Analysis tool: Vanderbilt Univ. “Rebound Calculator”
  - Uses 2018 baseline data on employment, remote working, transit and carpool commuting
  - Fits speed vs. travel volume relationships to historical data for sample cities
  - Calculates impacts of job losses, remote work, and shifts from transit and

Baseline Data for Sample Cities (early 2020)

Population Category	Urban Area	pre-Pandemic Baseline Data					
		Population (thousands) (1)	Employment (thousands) (2)	Transit Commute Share (3)	Carpool Commute Share (3)	Remote Work Share (3)	Average Commute Time (minutes) (4)
> 10 million	New York	19,216	10,019	30.9%	6.3%	4.7%	31.0
	Los Angeles	13,215	6,288	4.8%	9.5%	5.9%	31.6
5-10 million	Chicago	9,459	4,771	12.1%	8.0%	5.4%	30.1
	Philadelphia	6,102	2,995	9.8%	7.2%	5.5%	28.7
	Washington, D.C.	6,280	3,380	13.0%	9.2%	6.1%	34.3
	Dallas	7,573	3,851	1.3%	9.5%	5.8%	28.8
	Houston	7,066	3,208	2.0%	9.4%	4.9%	30.4
	Miami	6,166	2,732	3.1%	9.2%	5.7%	29.9
	Atlanta	6,020	2,884	3.0%	8.9%	7.6%	32.3
3-5 million	Boston	4,873	2,814	13.2%	7.0%	5.5%	31.7
	San Francisco	4,732	2,498	17.3%	9.6%	7.0%	34.3
	Seattle	3,980	2,116	10.7%	10.0%	6.7%	30.6
	Minneapolis	3,640	2,031	4.5%	8.1%	5.9%	25.4
	Phoenix	4,948	2,220	1.8%	11.2%	7.4%	26.1
	Detroit	4,320	2,048	1.3%	8.6%	4.3%	27.4
	San Diego	3,338	1,516	2.6%	8.8%	6.6%	26.9
1-3 million	Baltimore	2,800	1,437	6.0%	8.0%	5.3%	29.9
	Portland	2,942	1,230	6.1%	8.8%	8.1%	27.0
	Pittsburgh	2,318	1,197	5.6%	8.3%	5.1%	26.6
	St. Louis	2,803	1,398	2.1%	6.9%	4.6%	25.9
	Denver	2,967	1,558	3.8%	8.2%	8.7%	27.6
	Charlotte	2,637	1,251	1.5%	9.4%	7.3%	27.4

Immediate Impacts (March-June 2020)

Population Category	Urban Area	Estimated Changes from Baseline Values: March-June 2020 (percent)							
		Employment Loss (IHS forecast 2020 Q2) (5)	Decline in Transit Ridership (6)	Shift from Transit to SOV	Decline in Carpool Commuting (7)	Shift from Carpool to SOV	Maximum Remote Work Share (All Employment) (8)	Change in Remote Work Share from Baseline	Average Commute Time (minutes) (4)
> 10 million	New York	-19%	-90%	-72%	-56%	-45%	42%	37%	26.7
	Los Angeles	-20%	-80%	-76%	-56%	-45%	39%	33%	24.1
5-10 million	Chicago	-18%	-88%	-81%	-56%	-44%	39%	34%	26.1
	Philadelphia	-19%	-97%	-90%	-56%	-43%	40%	35%	21.8
	Washington, D.C.	-17%	-85%	-77%	-56%	-45%	50%	44%	32.8
	Dallas	-18%	-75%	-72%	-56%	-42%	40%	34%	25.3
	Houston	-17%	-55%	-52%	-56%	-43%	37%	32%	26.0
	Miami	-21%	-80%	-77%	-56%	-46%	37%	31%	24.0
	Atlanta	-20%	-67%	-65%	-56%	-44%	40%	33%	27.6
3-5 million	Boston	-20%	-92%	-84%	-56%	-43%	44%	39%	24.0
	San Francisco	-19%	-92%	-82%	-56%	-45%	45%	38%	19.7
	Seattle	-20%	-77%	-71%	-56%	-44%	42%	36%	22.7
	Minneapolis	-18%	-60%	-56%	-56%	-40%	41%	35%	24.2
	Phoenix	-20%	-45%	-41%	-56%	-41%	39%	32%	24.4
	Detroit	-22%	-80%	-77%	-56%	-42%	35%	31%	24.8
	San Diego	-18%	-65%	-63%	-56%	-44%	40%	33%	21.7
1-3 million	Baltimore	-18%	-62%	-57%	-56%	-47%	42%	36%	23.9
	Portland	-19%	-70%	-66%	-56%	-42%	39%	31%	21.7
	Pittsburgh	-20%	-73%	-68%	-56%	-39%	37%	32%	23.2
	St. Louis	-19%	-40%	-38%	-56%	-41%	38%	33%	20.6
	Denver	-19%	-70%	-67%	-56%	-44%	43%	34%	24.4
	Charlotte	-20%	-52%	-51%	-56%	-40%	38%	31%	24.4

Improved Testing and Treatment (mid-2021?)

Population Category	Urban Area	Estimated Changes from Baseline Values: Early to Mid-2021 (percent)					
		Employment Loss (IHS forecast 2021Q2)	Shift from Transit to SOV	Shift from Carpool to SOV	Change in Remote Work from Baseline	Average Commute Time (minutes)	Change in Remote Work Share Necessary to Maintain Baseline Commute Time
> 10 million	New York	-14%	-44%	-24%	19%	25.7	8%
	Los Angeles	-13%	-45%	-24%	17%	25.5	0%
5-10 million	Chicago	-12%	-49%	-23%	17%	26.9	0%
	Philadelphia	-13%	-54%	-22%	17%	23.2	0%
	Washington, D.C.	-11%	-46%	-25%	22%	32.9	0%
	Dallas	-13%	-43%	-22%	17%	25.9	0%
	Houston	-14%	-30%	-22%	16%	26.7	0%
	Miami	-15%	-46%	-25%	16%	25.0	0%
	Atlanta	-13%	-39%	-24%	16%	28.5	0%
3-5 million	Boston	-15%	-50%	-22%	19%	25.0	0%
	San Francisco	-13%	-49%	-25%	19%	22.3	1%
	Seattle	-14%	-42%	-24%	18%	24.0	0%
	Minneapolis	-13%	-33%	-19%	18%	24.3	0%
	Phoenix	-14%	-24%	-21%	16%	24.7	0%
	Detroit	-16%	-45%	-22%	15%	25.2	0%
	San Diego	-12%	-37%	-24%	16%	22.7	0%
1-3 million	Baltimore	-12%	-34%	-27%	18%	24.9	0%
	Portland	-13%	-40%	-22%	15%	22.9	0%
	Pittsburgh	-14%	-40%	-18%	16%	23.8	0%
	St. Louis	-13%	-22%	-20%	16%	21.6	0%
	Denver	-14%	-40%	-24%	17%	24.9	0%
	Charlotte	-12%	-31%	-20%	15%	25.1	0%

Assumption	Value
Fraction of Former Transit Riders Returning	40%
Fraction of Non-Household Carpool Members Returning	40%
Fraction of Maximum Remote Work Share Continuing to Work Remotely	50%

Widespread Vaccination (2022?)

Population Category	Urban Area	Estimated Changes from Baseline Values: 2022 (percent)					
		Employment Loss (IHS forecast 2022Q2)	Shift from Transit to SOV	Shift from Carpool to SOV	Change in Remote Work from Baseline	Average Commute Time (minutes)	Change in Remote Work Share Necessary to Maintain Baseline Commute Time
> 10 million	New York	-8%	-21%	-9%	9%	29.3	4%
	Los Angeles	-8%	-22%	-9%	8%	27.6	0%
5-10 million	Chicago	-7%	-24%	-7%	8%	28.2	0%
	Philadelphia	-7%	-26%	-7%	9%	25.2	0%
	Washington, D.C.	-5%	-23%	-10%	11%	33.5	0%
	Dallas	-6%	-20%	-6%	8%	27.1	0%
	Houston	-8%	-14%	-7%	8%	27.9	0%
	Miami	-7%	-23%	-10%	8%	26.9	0%
	Atlanta	-5%	-19%	-9%	8%	30.2	0%
3-5 million	Boston	-8%	-25%	-7%	10%	27.5	0%
	San Francisco	-7%	-24%	-10%	9%	27.8	1%
	Seattle	-8%	-21%	-9%	9%	26.4	0%
	Minneapolis	-6%	-16%	-4%	9%	24.8	0%
	Phoenix	-6%	-11%	-6%	8%	25.3	0%
	Detroit	-9%	-21%	-6%	8%	25.9	0%
	San Diego	-6%	-18%	-8%	8%	24.3	0%
1-3 million	Baltimore	-6%	-16%	-11%	9%	26.8	0%
	Portland	-6%	-20%	-6%	8%	24.5	0%
	Pittsburgh	-8%	-19%	-2%	8%	24.8	0%
	St. Louis	-8%	-10%	-4%	8%	23.0	0%
	Denver	-6%	-20%	-8%	8%	26.1	0%
	Charlotte	-4%	-15%	-4%	8%	26.1	0%

Assumption	Value
Fraction of Former Transit Riders Returning	70%
Fraction of Non-Household Carpool Members Returning	70%
Fraction of Maximum Remote Work Share Continuing to Work Remotely	25%

Residual Impacts (beyond 2022)

Population Category	Urban Area	Estimated Changes from Baseline Values: Post-2022					
		Employment Loss (IHS forecast 2023Q4)	Shift from Transit to SOV	Shift from Carpool to SOV	Change in Remote Work from Baseline	Average Commute Time (minutes)	Change in Remote Work Share Necessary to Maintain Baseline Commute Time
> 10 million	New York	-3%	-14%	-3%	7%	30.3	5%
	Los Angeles	-3%	-14%	-4%	7%	28.9	0%
5-10 million	Chicago	-2%	-16%	-2%	7%	28.9	1%
	Philadelphia	-1%	-17%	-2%	7%	27.0	2%
	Washington, D.C.	1%	-15%	-5%	9%	33.9	5%
	Dallas	1%	-13%	-1%	7%	27.9	2%
	Houston	-1%	-9%	-2%	6%	29.2	0%
	Miami	2%	-15%	-5%	6%	29.1	3%
	Atlanta	4%	-13%	-3%	7%	31.9	5%
3-5 million	Boston	-1%	-17%	-2%	8%	29.7	3%
	San Francisco	0%	-16%	-5%	8%	31.7	5%
	Seattle	-1%	-14%	-4%	7%	28.6	2%
	Minneapolis	0%	-10%	1%	7%	25.1	2%
	Phoenix	3%	-6%	-1%	6%	25.9	4%
	Detroit	-3%	-13%	-1%	6%	26.5	0%
	San Diego	0%	-12%	-3%	7%	25.5	1%
1-3 million	Baltimore	0%	-10%	-6%	7%	28.4	2%
	Portland	0%	-13%	-1%	6%	25.9	2%
	Pittsburgh	-3%	-12%	3%	6%	25.5	0%
	St. Louis	-2%	-7%	1%	7%	24.1	0%
	Denver	1%	-13%	-3%	7%	26.9	2%
	Charlotte	4%	-10%	1%	6%	27.2	5%

Assumption	Value
Fraction of Former Transit Riders Returning	80%
Fraction of Non-Household Carpool Members Returning	80%
Fraction of Maximum Remote Work Share Continuing to Work Remotely	20%

Potential Evolution of Impacts: New York

Conclusions

- Most cities saw large reductions in commuting times during the immediate aftermath of the pandemic
- With 80% return to transit and carpooling, and employment back to pre-pandemic levels, only modest (3-4%) increases in remote working would be necessary to prevent increased commuting times
  - New York and San Francisco would need ~6% increases
  - But pre-pandemic remote work shares were only 4-8%, so adding 3-4% is a lot
- Intuition: almost everyone was *already* driving, except in a few cities

Limitations of Our Analysis

- Significant uncertainties about the pandemic and recovery remain:
  - Timing of recovery phases (more reliable testing, improved treatment, widespread vaccination)
  - Extent and timing of restoration in transit capacity
- Modeling limitations:
  - Commuting times and estimated changes are averages over entire urban areas, and both will vary widely within individual urban areas
    - Highway capacity and transit service vary widely across commuting corridors within urban areas
    - Geographic distribution of workplaces and preferred departure times also affect commuting times
  - Relationships between travel volume and speed apply to entire urban

Critical Uncertainties

- How much of transit capacity will ultimately be restored, and when?
  - Depends partly on cleaning protocols, passenger management practices
  - But also depends on traveler reactions, car ownership among former transit users, where commuters' jobs are located
- How widespread will remote working remain?
  - What industries and occupations lend themselves to it?
  - How much of total employment do they account for?
  - Will industries where it can work continue to embrace it?
  - How many employees have suitable spaces, and want to use them?

What Can DOT Do to Address Congestion?

- Focus on solutions to congestion, treating modes as an interdependent system
  - Work with transit agencies to develop most effective methods to restore service, capacity, and rider confidence
  - Identify industries and occupations amenable to sustained remote working and encourage it through existing programs
    - Seemingly amenable: government, technology, finance, education
    - Probably not: health care, manufacturing, retail, food service
- Identify and promote helpful changes in travel behavior
- Search for policy and technology responses to mitigate changes that increase congestion

Potential Follow-On Analysis: Updates

- Update the analysis as new information becomes available
  - What if transit capacity takes longer to restore, or never gets back to 100%?
  - What if non-household carpool members never re-join?
  - What will it take to sustain increases in remote working?
    - Remote work shares have only increased by 3-4 percentage points over the past decade, even with huge improvements in remote network access and sharing platforms
    - How many employers (and employees) actually want to continue it?
- Explore how to incorporate geographic and time-of-day variation into the model, to enable identification of specific problem areas and additional solutions